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ABSTRACT

While the use of informational graphics in newspapers is increasing, little is known regarding how well readers can understand them and how readers use them. A study investigated whether readers of newspapers read graphics before or after they read the headline/text, and whether people decide to read a graphic device for appearance-related or content-related reasons. Subjects, 70 undergraduate students at two universities, were shown two separate "packages" from "USA Today" (one with a dominant graphic, and one with a non-dominant graphic) consisting of news articles, a headline, and a graphic device. They were then asked five questions based on the content of the graphic devices in the two packages. Results suggest that readers turn to graphics for both content-based and appearance-related reasons, which may be based on individual tastes or on the dominant status of the graphic. For example, 70% of the subjects read the dominant graphic before the headline/text, while the smaller, less ostensible graphic was generally read after the headline and text. Results also suggest that readers went to the informational graphics largely for content-related reasons, indicating that there may be a need to emphasize the information in infographics. (Eight tables of data and 25 notes are included. An appendix contains the two packages.) (SR)

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# Reader Use and Understanding of Newspaper Informational Graphics

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## Reader Use and Understanding of Newspaper Informational Graphics

Today's newspapers not only must use text and photos to report the news. With increasing regularity, newspapers are relying on informational graphics to complete the story.

These devices, ranging from simple pie graphs to complex graphic devices, have become the rule rather than the exception in a large number of daily newspapers. Scripps-Howard managers recently said, "Reporters should always think visually--either a photo or a graphic."[1]

However, increasing the use of modern graphs and charts and adding a splash of color cannot be seen as the quick fix to declining circulation.[2]

Between 1984 and 1988 the number of newspapers with graphic capabilities grew from 40% to 90%,[3] according to two surveys by the Society of Newspaper Design. In another survey, conducted by the American Society of Newspaper Editors, 90% of those responding predicted that graphic usage will overtake photographic usage.[4]

Other studies have found a general increase in the use of a variety of modern graphic devices[5] and in *USA Today*-type design.[6] With greater use in three-dimensional graphs,[7] today's daily newspaper is perceived as neater and more organized than its traditional-looking counterpart.[8] As the trend continues, the outlook is for the increased use of graphics which can stand alone without an accompanying story.[9]

This trend may be due in part to the increasingly affordable technology. Three quarters of all newspapers surveyed in 1988 use a graphics wire and 80% had a Macintosh system.[10] Increased usage in these two technologies will allow easier access for newspapers to a daily menu of charts, maps and graphs.

Regardless of the size of the paper,[11] graphics will play a bigger role by the 2000 as graphic devices are increasingly viewed as basic communication tools rather than creative focal points.[12]

But, while it is now well established that informational graphics are becoming increasingly popular and prevalent, little is known regarding how well readers can understand them, and no research has yet tackled the question of how readers use these modern devices.

The purpose of this paper is to examine how and why readers select newspaper infographics. Specifically, this paper will seek to answer two basic questions:

1. Do readers of newspapers read graphics before or after they read the headline/text?

2. When people decide to read a graphic device, do they do so for appearance-related or content-related reasons?

Previous research has found that the use of bar charts, maps, and tables increased reader retention[13] and reader recall.[14] The use of bar graphs provided for more efficient subject performance on recall tasks. Both reader response levels and content understanding were also affected, as graphics not only had an effect on response time, but also had a reliable effect on accuracy. The error rate in subject response in the graphic-condition was half that in the text-only condition.[15]

In another study that used technical information, subjects reading the graphic-organized text were better able to write a summary of the material than the group which had read text only.[16]

It has also been found that graphics can divert and entertain those in the audience who find the text too difficult,[17] but, on the other hand, some studies have suggested today's modern and complex graphs and charts require a more sophisticated audience.[18]

Graphics are geared toward performing several functions: show data, avoid distortion, present many numbers in a small space, make a large data set coherent, and induce the reader to think about the substance. Tufte wrote that graphics need to do more than simply decorate a page or describe some phenomenon.[19] He called

adornment in graphics "chartjunk," saying that a large share of the ink on a graphic should present data-information, the ink changing as the data change. At their best, graphics are instrumental for reasoning about quantitative information, often the most effective way to describe, explore and summarize a set of numbers.[20]

Others suggest that graphic artists should shock the reader into reading the graphic. That can be accomplished, one author suggests, by doing everything in negative (reverse) or by placing the graphic in an unusual position on the page. Regardless of the placement or the type style, the graphic should be simple. If the chart looks easy (even when it is not), there is a chance that it will be read.[21] Using the element of surprise, such as smaller charts or increasing the surrounding white space can also help bring the reader to the chart.[22]

Design principles indicate that illustrations (photographs and artwork) can attract attention, aid in retention, inform, entertain, show a relationship, and help to pull a reader into a design.[23] It remains to be seen if these general design principles can be applied to informational graphics on a newspaper page.

**Method**

Subjects were undergraduate students at two universities. They were shown two separate "packages" from an issue of *USA Today*. Each "package" consisted of a news articles, a headline and a graphic device--chart, cartoon, graph.

The first package (See Appendix A) dealt with coolants and their effects on the ozone layer. The graphic device was located above the story and headline, had a 24-point headline of its own, two bar graphs, a pie chart and a "chartoon"--chart with adornment.[24] The body copy of the news article, combined with the headline, consumed a width of 3.5 inches and a depth of 7 inches. The graphic device was 5.5 inches wide, 6.5 inches deep and contained several colors.

The second package (See Appendix B) concerned gasoline prices. It consisted of a

three-line, two column 36-point headline and two columns of body text. The graphic device--a ledger chart--was located at the top of the second column of the story. The package was 3.5 inches wide and 8.5 inches deep overall. The chart itself, embedded in the text, took up 1.75 inches of width and three inches of depth. It was in two colors and had a 14-point headline of its own.

The coolant package was chosen to represent a dominant graphic device, while the smaller gasoline price chart was chosen to represent a non-dominant graphic.

Subjects were presented first with the coolant package. They were instructed to read the entire package and indicate whether they read the graphic first or the headline/text first. They were requested to rank the top three reasons for their choices of reading order. Choices for reading order selection were based either on appearance-related or content-related reasons. The procedure was repeated for the gas prices package.

Weights were assigned to each of the reasons subjects gave for their choice of reading order. First choices were assigned 3 points, second choices 2 points and third choices 1 point.

**The Sample**

The sample size of 70 had a mean age of 26.3 years old, watched an average of 2.5 hours of television per day and averaged five days per week reading a newspaper. Of the 70 subjects, 37 were female.

**Understanding the Graphics**

Subjects were asked five questions based on content of the graphic devices in the two packages. Four of the questions involved simply reading information from the various charts and graphs. The fifth item involved executing a subtraction from one of the charts.

Questions and how the subjects answered included:

1. Name the American/Canadian company that has the largest market share of chlorofluorocarbons (CFCs). *2 incorrect, 68 correct.*

2. What product(s) is/are the second greatest user of CFCs? *4 incorrect, 66 correct.*

3. The smallest amount of USA sales of CFCs occurred in what year? *2 incorrect, 68 correct.*

4. Crude oil prices were the lowest in what month in 1988? *26 incorrect, 44 correct.*

5. What was the difference in price for one gallon of gasoline between August 1987 and August 1988? *18 incorrect, 52 correct.*

The likelihood of the ability to correctly read the graphics was not related to newspaper readership in general. There were no significant differences found between persons who described themselves as regular readers of newspapers and those who did not.

**Reading Order Results**

For the coolant package featuring the dominant graphic, 49 of the 70 subjects (70 %) read the graphic first while 21 (30%) read the headline or article first.

For the gasoline price package featuring the non-dominant graphic, 13 of the 70 subjects (18.6%) read the graphic first while 57 (81.4%) read the headline or article first.

Overall, among the 70 subjects, 10 (14.3%) read both graphics first and 18 (25.7%) read the article/headline first in both cases. Three subjects (4.3%) read the graphic first for the gas prices package and the headline/text first for the coolant package, and 39 subjects (55.7%) read both the coolant graphic first and the gas prices headline/text first.

**Reasons for Choices Results**

Coolant package: Of the 49 subjects who selected the graphic first, 44.9% did so for appearance-related reasons and 55.1% made the choice for content-based reasons.[25] (See Tables 1 and 2)

Of the subjects who read the graphic second, 71.4% did so for content-based reasons. (See Tables 3 and 4)

Gas prices package: Of the 13 subjects who selected to read the graphic before the text or headline, 84.6% did so for appearance-related reasons and 15.4% did so for content-related reasons. (See Tables 5 and 6)

Of the subjects who read the graphic second, 69.8% did so for content-based reasons. (See Tables 7 and 8)

No significant differences were found for reading choices between subjects who described themselves as regular (5 or more days) newspaper readers and those who described themselves as less regular readers. Among the regular readers, 67.6% read the graphic first in the coolant package, compared to 72.2% of the non-regular readers ($x^2$=.025, df=1, p=.875).

For the gasoline prices graphic, 17.6% of the regular newspaper readers went to the graphic first, compared to 19.4% of the less regular readers. ($x^2$=.01, df=1, p=.91).

Nor was the age of the subjects related to reading order. For the coolant package, 68.8% of subjects aged 25 and under read the graphic first, compared to 72.7% of those older than 25 ($x^2$=.003, df=1, p=.96). For the gas prices package, 25% of those 25 or younger read the graphic first, compared to 4.8% of the subjects older than 25 ($x^2$=3.28, df=1, p=.08).

**Discussion**

As informational graphics have become more common in newspapers in the last decade, researchers have discovered that readers attend to them, can generally

understand them, and, as a rule, like them. Exactly how and why informational graphics are used by newspaper readers, however, has not been studied.

Specifically this study sought to discover if readers attend to informational graphics before or after they read the traditional headline and body text. Also, the research sought to find out why readers look at informational graphics, and if the reasons differ between those who read the graphics before the headline/text or after the headline/text.

This study constitutes a preliminary attempt to better understand the relationship between informational graphics and headlines/text from the perspective of the reader. Results suggest that readers turn to the graphs and charts for both content-based and appearance-related reasons.

Perhaps the reason depends on the tastes of the individual reader, or perhaps it is based on the dominant status of the graphics device. For example, 70% of subjects read the large dominant informational graphic before they read the headline/text, while the smaller, less ostensible graphic was generally read after the headline and text. In addition to size and splashiness, the location, as it relates to the story, may also help determine if the infographic is read before or after the story. In this study the large and dominant graphic was atop its accompanying headline/text, while the smaller, non-dominant graphic was embedded in the body text.

Certainly, a large, colorful graphic attracts the eye, but results suggest that subjects went to the informational graphics mainly for content-related reasons. In the case of the large, dominant infographic, 55% used it as springboard into the article, read it because they felt it would be easier to capture the gist of the story content from the infographic, or felt that if they read the informational graphic, they could avoid the article altogether. And those who read the dominant graphic after the headline/text did so principally to expand upon what they had already read. Others indicated they read the headline/text first out of habit--they always go first to a headline.

Large dominant graphics are being used by many newspapers like they use large stand-alone photographs--as a design element to attract readers into the page. Graphics, therefore, could become as useful as photographs. Not only do they tell or complement a news or feature story, they also serve as an element of design. And in doing so, take on a more important function than just adding more words and lines to the page.

For the smaller graphic device, which most readers went to after reading the story and headline, a majority read the chart for content-related reasons, while only 3 of 57 did so for appearance-related reasons.

Clearly, the results indicate that there may be a need to emphasize the "info" in infographics. Readers, based on the data here, expect charts and other graphic devices to fulfill an informational gathering need. Perhaps they assume color and attractiveness as a given.

For editors and graphic artists, the first burden is to make graphs understandable. Obviously, information gain cannot occur if reader cannot grasp the graphic device. As Tankard indicated in his research, and as the results here suggest, readers are by no means graphic-reading experts. Only 2 of 70 subjects said they were more comfortable with graphs than text. In response to two of five "understanding" questions, substantial percentages of readers misread the graphic's contents. Editors need to be aware of the pitfalls of graphics, as Tankard suggests.

Beyond that, editors need to be conscious of the fact that different readers will read the infographics either before or after they read the article and headline. A fine line must be walked between not repeating the content of the article in the infographic while at the same time, realizing some readers (scanners) may get all they need from the graphic and then move on. Most readers, the data suggest, will take for granted the "looks" of the infographic and either read it to prepare for the story to come or as a supplement after the article has been read.

Perhaps, editors should view the informational graphic as "icing on the cake"--additional detail relating to a story which normally would be found in the latter portion of the article rather than the lead. Readers who want the additional information can peruse the infographic to obtain it. Of course, editors cannot assume how readers behave. Therefore, a further research question might be: When a reader "turns off" to an inverted pyramid story after 6 paragraphs, is he/she likely to go to the accompanying chart/graphic or onto the next story?

Editors need to be conscious of the fact that for many readers, infographics are either intimidating or fall into the category of something that should "be seen but not heard." Indeed, one in 10 subjects said if they had not been requested to do so, they would not have read the infographic at all.

Older audiences will likely cling to a reliance on text/headline out of habit, while the young graphically oriented computer-age readers are likely to find dealing with infographics a more comfortable proposition. Newspapers need to gauge their readership and determine the preferable route. Clearly, informational graphics are going to be a mainstay on America's news pages. Now, it is time to find out how readers use them and which gratifications they seek.

Clearly, more research is needed into the content/informational role of infographics. This study is a starting point only, but suggests that editors need to think of these new devices as information first and graphics second.

Table 1

First Choices for Reading the Coolant Graphic

Before the Text/Headline

| Reasons | N | Percentage |
|---|---|---|
| Graphic would help me understand story | 20 | 40.8% |
| Location of graphic related to story | 15 | 30.6% |
| Color of graphic | 5 | 10.2% |
| If I read the graphic, I wouldn't need to read the story | 4 | 8.2% |
| Graphic probably easier to read | 3 | 6.1% |
| Size of graphic | 2 | 4.1% |
| TOTAL | 49 | 100% |

Table 2

Weighted Scores* for Reading Coolant Graphic First

| Reason | Total Points |
|---|---|
| Location of graphic related to story | 82 |
| Graphic would help me grasp story | 70 |
| Color of graphic | 58 |
| Graphic would be easier to understand than the story | 34 |
| If I read the graphic, I wouldn't have to read the story | 18 |
| Size of graphic | 14 |
| Simplicity of the graphic's design | 4 |
| More comfortable with graphics | 2 |

*All first choices were given 3 points, second choices, 2 points and third choices, 1 point.

Table 3

## Reasons for Reading the Coolant Graphic Second

| Reasons | N | Percentage |
|---|---|---|
| To expand upon the headline and story | 12 | 57.1% |
| Habit: I always read headlines first | 5 | 23.8% |
| To expand upon the headline | 3 | 14.3% |
| Normally would not have read the graphic | 1 | 4.8% |
| TOTALS | 21 | 100% |

Table 4

## Weighted Scores* for Reading Coolant Prices Second

| Reasons | Total Points |
|---|---|
| To expand upon headline and story | 57 |
| Habit: I always read headlines first | 22 |
| Appearance of the graphic | 21 |
| To expand upon headline | 18 |
| Normally would not have read graphic | 8 |

*All first choices were given 3 points, second choices, 2 points and third choices, 1 point.

Table 5

First Choices for Reading the Gas Prices Graphic

Before the Text/Headline

| Reasons | N | Percentage |
|---|---|---|
| Simplicity of chart's design | 8 | 61.5% |
| Color of chart | 3 | 23.1% |
| If I read the graphic, I wouldn't need to read the story | 2 | 15.4% |
| TOTALS | 13 | 100% |

Table 6

Weighted Scores* for Reading Gas Prices Graphic First

| Reasons | Total Points |
|---|---|
| Simplicity of the graphic | 30 |
| Color of Graphic | 12 |
| Graphic easier to understand than story | 9 |
| If I read the graphic, I wouldn't have to read story | 6 |
| Size of graphic | 6 |
| Location of graphic related to story | 5 |
| More comfortable with graphics | 1 |

*All first choices were given 3 points, second choices, 2 points and third choices, 1 point.

Table 7

Reasons for Reading the Gas Prices Graphic Second

| Reasons | N | Percentage |
|---|---|---|
| To expand upon the headline and story | 29 | 51.8% |
| To expand upon the headline | 10 | 17.9% |
| Always read headlines first | 8 | 14.3% |
| Normally would not read graphic | 6 | 10.7% |
| Appearance of graphic | 3 | 5.4% |
| TOTALS | 56 | 100% |

Table 8

Weighted Scores* for Reading Gas Prices Graphic Second

| Reasons | Total Points |
|---|---|
| Graphic would expand upon headline and story | 148 |
| Graphic would expand upon the headline | 54 |
| Appearance of graphic | 54 |
| Habit: I always read headlines first | 38 |
| Normally would not have read the graphic | 36 |

*All first choices were given 3 points, second choices, 2 points and third choices, 1 point.

## Endnotes

[1]Workshop at *Commercial Appeal*, Memphis, TN., February 16, 1989.

[2]Rolf Rykken, "Readership Decline Brings Newspapers to Crossroads," *Presstime*, March 1989, pp. 22-24.

[3]Michael Emery, "New York Times Top Designers' List," *Advertising Age*, November 19, 198 pp. 36, 39. Pamela M. Terrell, "Art," *Presstime*, February 1989, pp. 20-27.

[4]Terrell, op. cit.

[5]Sandra H. Utt and Steve Pasternack, "How They Look: An Update of America's Front Pages," Paper presented to the Southwest Symposium for Research in Journalism and Mass Communication, Abilene, TX, October 1988.

[6]Paul Lester, "Use of Visual Elements on Newspaper Front Pages," *Journalism Quarterly*, Fall 1988, pp. 760-763.

[7]James Tankard, "Effects of Chartoons and Three-Dimensional Graphs on Interest and Information Gain," Presented at the Association for Education in Journalism and Mass Communication annual meeting, Portland, Oregon, 1988.

[8]Edward J. Smith and Donna J. Hajash, "Informational Graphics in 30 Daily Newspapers," *Journalism Quarterly*, Fall 1988, pp. 714-719.

[9]George Garneau, "Infographics," *Editor & Publisher*, October 22, 1988, p. 44.

[10]Utt and Pasternack, op. cit.

[11]Ibid.

[12]Terrell, op. cit.

[13]Becky K. Peterson, "Tables and Graphs Improve Reader Performance and Reader Reaction," *Journal of Business Communication*, Spring 1983, pp. 47-55.

[14]Jeane Amlund, Janet Gaffney and Raymond Kulhavy, "Map Feature Content and Text Recall in Good and Poor Readers," *Journal of Reading Behavior*, 17 (4), 1985, pp. 317-330.

[15]Paul Multer and Candace Mayson, "Role of Graphics in Item Selection from Menus," *Behavior and Information Technology*, 5 (1) 1986, pp. 89-95.

[16]Robert Waller and Peter Whalley, "The Processing of Graphically Organised Prose," Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, La., 1984.

[17]Donald McGregor and Paul Slovic, "Graphic Representation of Judgmental Information," *Human-Computer Interaction*, 1986 (3), pp. 179-200.

[18]E.A. Peel, "Generalizing Through the Verbal Medium," *British Journal of Educational Psychology*, February 1978, pp. 36-46.

[19]Edward R. Tufte, *The Visual Display of Quantitative Information* (Cheshire, Conn., Graphics Press, 1983).

[20]Ibid.

[21]Nigel Holmes, "Get Smart About Charts," *Publish!*, March 1989, pp. 42-45.

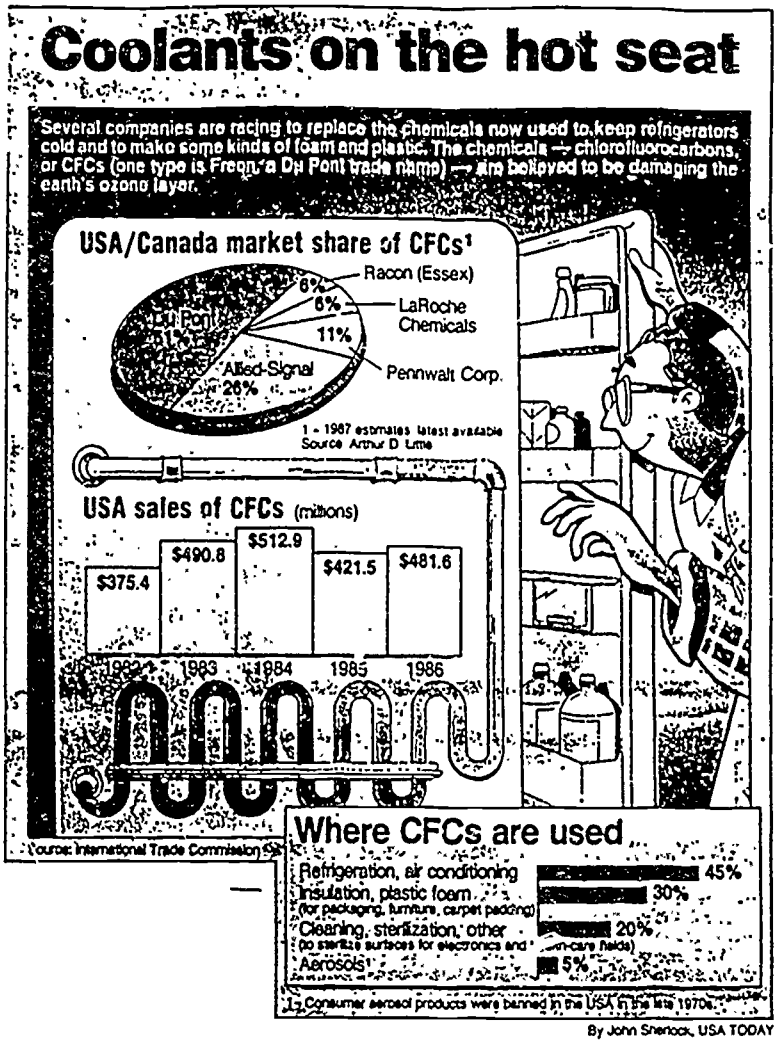
[22]Ibid.

[23]Russell Baird, Arthur Turnbull and Duncan MacDonald, *The Graphics of Communication*, 5th Edition, (New York: Holt, Rinehart and Winston, 1987).

[24]James Tankard, "Quantitative Graphics in Newspapers," *Journalism Quarterly*, Summer-Autumn 1987, pp. 406-415.

[25]Appearance-related reasons included: the graphics' color, size, location and design simplicity. Content-related reasons pertained to the understanding of the information contained in the headline and the body text.

Appendix A




COVER STORY

# Firms race to replace Freon

## Proposed ban, promise of high profits spur research

By Randy Whitestone
USA TODAY

The chemicals that cool your car, your office building and your refrigerator are on their way out. Now the great race is on to replace those chemicals without disrupting consumers' lives.

Today, Du Pont Co. strides into the lead. It plans a news conference in Washington, D.C., where it is expected to announce an aggressive plan to be on the market by 1993 with alternatives to chlorofluorocarbons — those ozone-eating chemicals dubbed CFCs. Du Pont's brand of CFC is more commonly known by the trade name Freon.

Why the race? Companies won't be able to sell the stuff much longer. CFCs leak from refrigerators and other cooling systems. Scientists say the chemical is whittling away the ozone, the layer of the earth's outer atmosphere that blocks much of the sun's ultraviolet rays. Forty-five nations, including the USA, have signed a pact — the Montreal Protocol — calling for a 50% cut in CFC production by 1998. This week, the U.S. Environmental Protection Agency and the industry called for a total ban by 2000.

The impending ban throws the $2 billion (worldwide annual sales) coolant business up for grabs. For players trying to gain market share, it's "a bonanza," says Robert S. Reitzes, analyst with Mabon, Nugent & Co. Du Pont, which makes more than half the CFCs sold in the USA, has four pilot plants producing alternatives — more volatile versions of CFCs that break apart before they can reach the ozone.

Other companies in the race: ICI Americas, the $4 billion (annual sales) U.S. unit of Britain's giant Imperial Chemical Industries PLC, and Allied-Signal Inc. ICI has a 15-20% share of the world CFC market, but is a minor factor in the USA. Bernard Sukornick, fluorocarbon research director



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Appendix B

# Gas prices: Down and heading lower

By Jon Newberry
USA TODAY

Gasoline prices should fall by 3 cents to 8 cents a gallon by November, now that the busy summer driving season has ended, analysts say.

Consumers already are seeing some relief, thanks to a surge in gasoline imports that began in late August.

"That really softened prices in the whole market," says Dennis Eklof, an analyst with Cambridge Energy Research Associates in Cambridge, Mass.

Profit margins are high enough that U.S. distributors can import foreign gasoline and make money despite transportation costs, Eklof says.

According to the Lundberg Survey, the average price of gas at the pump has fallen about 2 cents a gallon from its August peak. In its Sept. 9 to Sept. 23 survey, the average price of all grades was $1.02; self-serve regular unleaded gasoline was 92.3 cents.

The downward trend is expected to continue as gasoline consumption tapers off further, says Trilby Lundberg, president of Lundberg Survey Inc.

Lower-than-normal gasoline supplies have kept prices high this year despite falling crude oil prices.

On the New York Mercantile Exchange, the price of West Texas intermediate, the U.S. benchmark crude oil, slipped 3 cents to $14.11 a barrel Wednesday — that's down from more than $17 a barrel in January.

Among the factors that have kept gasoline supplies tight and prices up:

▶ The amount of gasoline refineries get from a barrel of oil has declined because they're producing more high-octane unleaded gasoline.

▶ U.S. refining capacity has declined about 10% over the past five years.

▶ Refinery capacity has been used to make more profitable chemicals, rather than gasoline.

Prices could drop further than expected if crude oil falls below $14 a barrel and stays there for several months, experts say.

Members of the Organization of Petroleum Exporting Countries are apparently increasing crude oil production, ignoring their quotas. But meetings to stabilize output are set for next month.

## Gas vs. oil

Now that the summer driving season is over, gasoline prices are starting to reflect recent drops in crude oil prices.

| | Gas[1] (gallon) | Oil[2] (barrel) |
|---|---|---|
| 1987 | | |
| Aug. | 95.4¢ | $20.23 |
| 1988 | | |
| April | 94.5¢ | $17.91 |
| May | 96.2¢ | $17.45 |
| June | 95.0¢ | $16.58 |
| July | 97.0¢ | $15.46 |
| Aug. | 94.4¢ | $15.52 |

1 - Avg. pump price, self-service unleaded; 2 - Avg. price, West Texas intermed., N.Y. near-month futures

Source: USA TODAY research